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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/414,526	10/08/1999	YEONG-KWAN KIM	SEC.637	3413

7590 05/06/2004
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EXAMINER

CLEVELAND, MICHAEL B

ART UNIT PAPER NUMBER

1762

DATE MAILED: 05/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/414,526

Applicant(s)

KIM ET AL.

Examiner

Michael Cleveland

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cb

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 February 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 15-27 is/are pending in the application.
- 4a) Of the above claim(s) 20 and 26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 15-19, 21-25, 27 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

1. In view of the Appeal Brief filed on 2/5/2004, PROSECUTION IS HEREBY REOPENED. New grounds of rejection are set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

- (1) file a reply under 37 CFR 1.111 (if **this Office action is non-final**) or a reply under 37 CFR 1.113 (if this Office action is final); or,
- (2) request reinstatement of the appeal.

If reinstatement of the appeal is requested, such request must be accompanied by a supplemental appeal brief, but no new amendments, affidavits (37 CFR 1.130, 1.131 or 1.132) or other evidence are permitted. See 37 CFR 1.193(b)(2).

Election/Restriction

2. Claims 20 and 26 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 15-18 and 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. (Appl. Phys. Lett., **71**, pp. 3604-3606, hereafter Kim) in view of Yun et al. (U.S. Patent 6,447,908, hereafter '908) and Soininen (U.S. Patent 5,496,597, hereafter '597).

Claims 15, 17, 25, and 27: Kim teaches an atomic layer deposition (ALD) reaction loading a silicon substrate into a reaction chamber, dosing with TMA, which inherently chemisorbs to the surface, purging with argon, which inherently removes any physisorbed TMA,

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injecting (flushing with) water to react with the TMA to form an alumina film, and repeating the dosing, purging, and injecting steps to build an alumina film (p. 3604). The substrate is held at 370 °C.

Kim does not teach flushing the surface of the substrate with oxygen to uniformly terminate the surface with oxygen.

Yun '908 teaches the standard features of ALD, in which reactant vapors are alternately pulsed onto a substrate. Yun does not attribute any advantage to the order of the reactants. Further, it has been held that the selection of any order of performing process steps is *prima facie* obvious in the absence of new or unexpected results; *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946).

Soininen '597 teaches that oxygen may be used instead of water as the reactant in ALD reactions to deposit metal oxide films, such as alumina (col. 13, lines 23-29). The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07.

Therefore, taking the references as a whole, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have use oxygen instead of water as the oxygen precursor because '597 teaches that oxygen is operative as the oxygen precursor during ALD of metal oxide films and it would have been obvious to one of ordinary skill in the art at the time the invention was made deposited the metallorganic precursor (TMA) and oxygen in either order because it has been held that any order of performing process steps is *prima facie* obvious in the absence of new or unexpected results.

Flowing oxygen as the first reactant onto the silicon film would necessarily have uniformly terminated the substrate with oxygen atoms, as disclosed by Applicant (p. 6, lines 10-17).

Claim 16: The purging steps inherently remove physisorbed material. (Applicant recognizes that the feature achieved by purging, for instance, at p. 11, lines 6-11).

Claim 18: The selection of something based on its known suitability for its intended use has been held to support a *prima facie* case of obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07. The art recognizes both water and oxygen as suitable oxygen precursors for forming metal oxide films as discussed above. Therefore, for each oxygen precursor pulse, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have chosen the precursor from oxygen or water with a reasonable expectation of success because both are disclosed as suitable

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oxygen precursors for ALD of metal oxides. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used, for instance, oxygen as the first oxygen precursor pulse and water for the remaining oxygen precursors pulses with a reasonable expectation of success because both oxygen and water are recognized as suitable oxygen precursors.

Claim 21: Kim teaches that the substrate may be cleaned of a native oxide before being loaded into the chamber, but does not explicitly state that the cleaning step comes before loading the substrate into the chamber. However, it appears that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have provided the cleaning step before loading the substrate into the ALD chamber in order to avoid damage to and contaminants in the ALD chamber by the HF used in the cleaning process.

Claim 22-23: A final purge inherently removes the by-products and any intermediates of the reaction (p. 3604, col. 2). Methane (CH_4) is a by-product of the reaction (p. 3604, col. 1).

Claim 24: The step of introducing oxygen must occur for finite period of time, and therefore that period can be subdivided into the first half of the time, during which oxygen is introduced the first time, and the second half of the time, during which oxygen is introduced a second time.

5. Claims 19 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of Yun '908 and Soininen '597 as applied to claim 15 above, and further in view of Comizzoli et al. (U.S. Patent 5,851,849, hereafter '849).

Kim, '579, and '996 suggest the formation of an alumina film by ALE, but do not explicitly teach the formation of other oxide films.

'849 teaches that other oxide films than alumina, such as TiO_2 , may be formed by ALE using other metal precursors (col. 7, lines 1-42).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the method of Kim, '579, and '751 to have formed a film of a different metal oxide, such as titania with a reasonable expectation of success because '849 teaches that the process can be adapted to other metal oxides, and indicates that those metal oxides are of interest as passivating films.

Claim 27: '849 further teaches that ALD of alumina may take place at reaction temperatures of about 300 °C (col. 6, lines 11-24).

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Response to Arguments

6. Applicant's arguments filed 2/5/2004 have been fully considered but they are not persuasive.

The rejections over Kim in view of Marcus and Luryi (and Comizzoli) are withdrawn because, upon reconsideration, Marcus is not considered to fairly teach or suggest the equivalence of uniform termination with hydrogen and uniform termination of oxygen in an ALD process of forming a metal oxide on a silicon substrate. However, upon further consideration, a new ground(s) of rejection is made in view of Kim in view of Yun and Soininen (and Comizzoli).


Applicant's arguments regarding that Kim teaches the removal of native oxides by uniformly terminating with hydrogen. The argument is not relevant to the current rejection because the claims do not exclude pretreatment of the substrate by removing native oxides before performing the claimed process. In fact, claim 19 specifically requires removal of impurities before loading the substrate into the reaction chamber.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael Cleveland whose telephone number is (571) 272-1418. The examiner can normally be reached on Tuesday-Friday and alternate Mon, 8-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Michael Cleveland
Patent Examiner
May 3, 2004